Uncertainty assessment of forest carbon balance

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Introduction

- IPCC good practice guidance (2004) sets requirements to assess uncertainty of the national GHG inventories including LULUCF sector
- Uncertainty analysis not included in current reporting of LULUCF sector
- No examples of uncertainty analysis covering all pools (living biomass, dead wood, litter & SOM)

Objectives of this work

- To assess uncertainty of the carbon budget of Finnish forests 1922-2002
  - To identify sources of error and their uncertainties
  - To identify the key variables affecting the uncertainty of carbon budget of Finnish forests

Methods

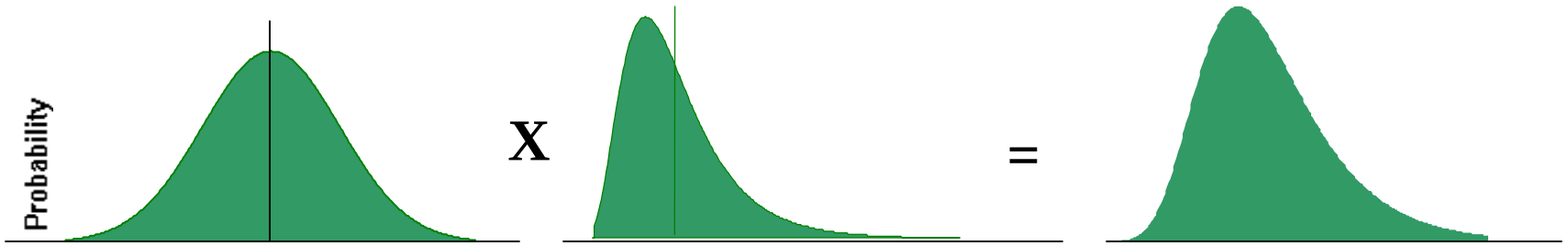
- IPCC GPG presents two methods to estimate uncertainty
  - TIER 1, error propagation equations
  - TIER 2, Monte Carlo analysis

- TIER 2 Method selected because
  - Sample distributions often cut (no values less than zero allowed) or skewed
  - Handling of correlations easier

Methods

Monte Carlo Simulations

- Input parameters of calculation are replaced with probability density functions (e.g. normal or lognormal distributions)
- Total uncertainty is obtained performing calculation by taking random numbers from each input distribution several thousands of times



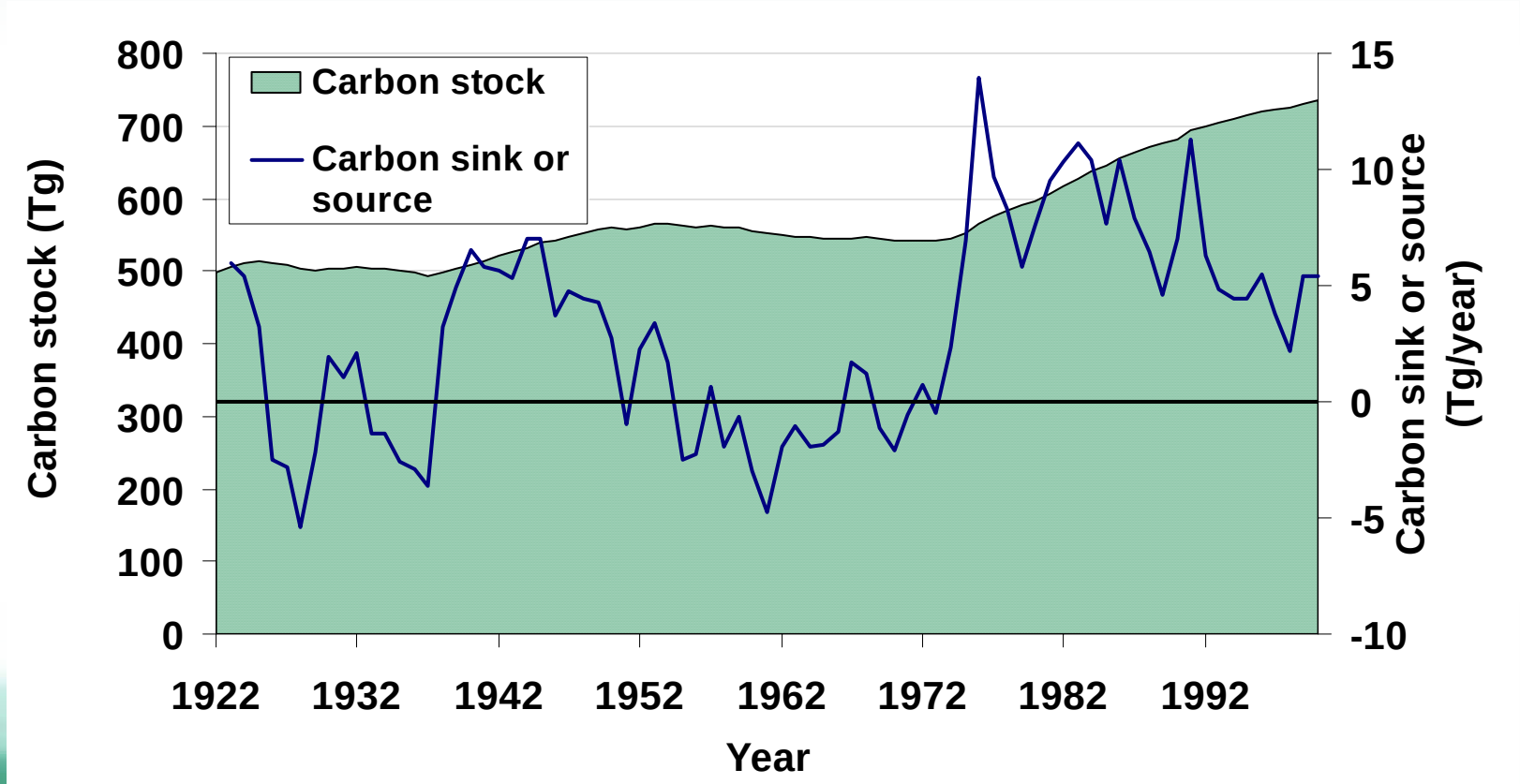
Input parameter 1 distribution

Input parameter 2 distribution

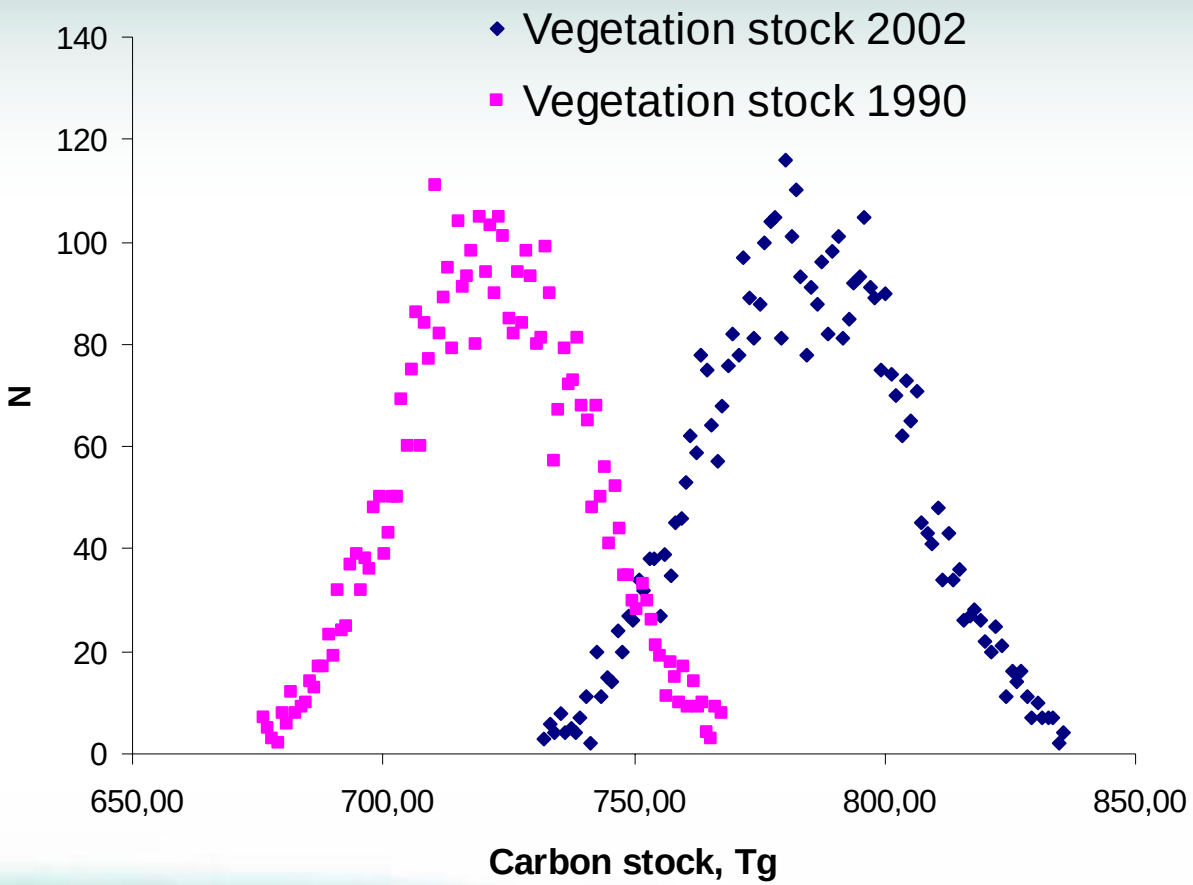
Result distribution

Sources of errors and preliminary results presented for

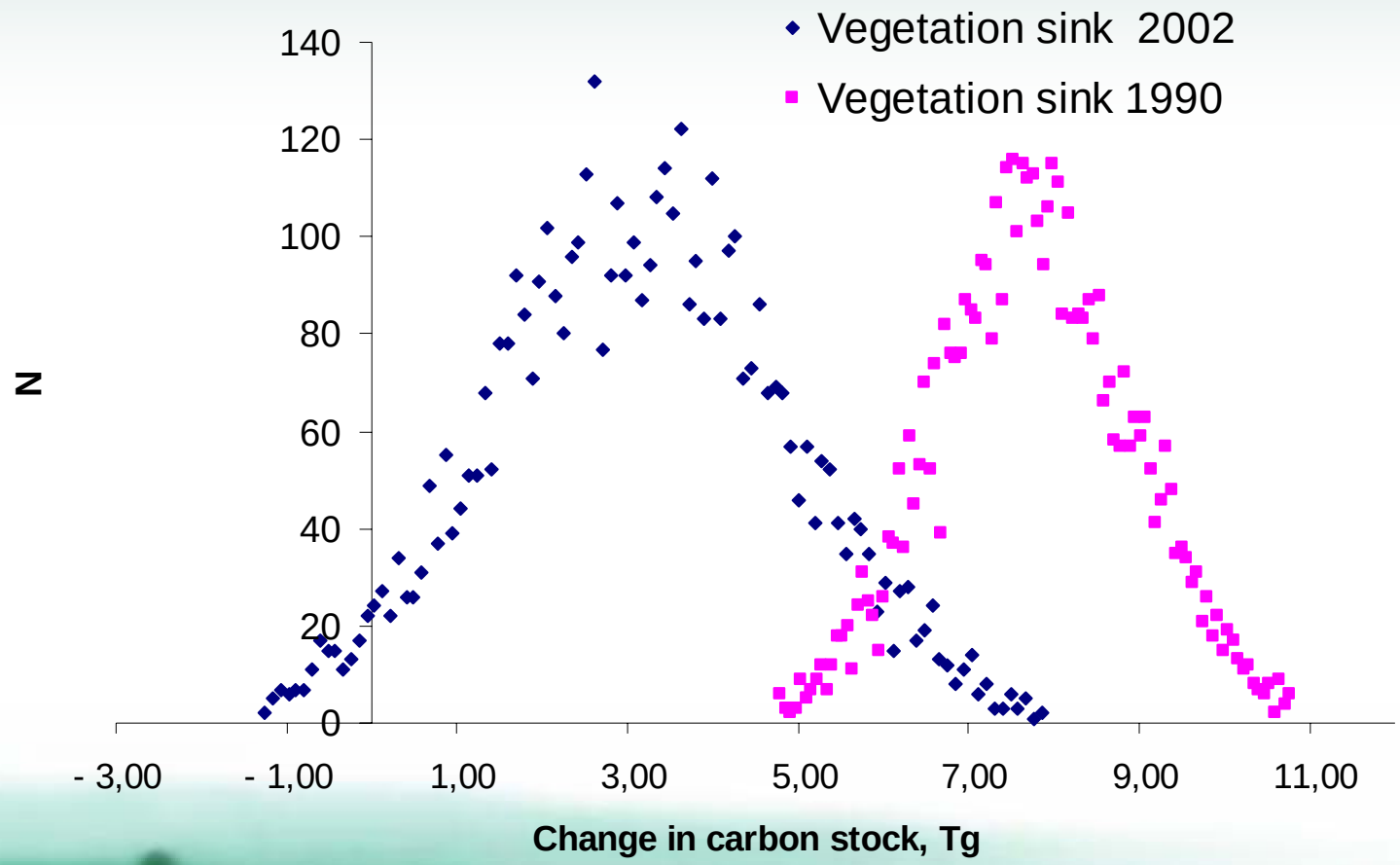
- carbon stock of living biomass and C sink/source of biomass
- soil carbon pool and soil sink/source



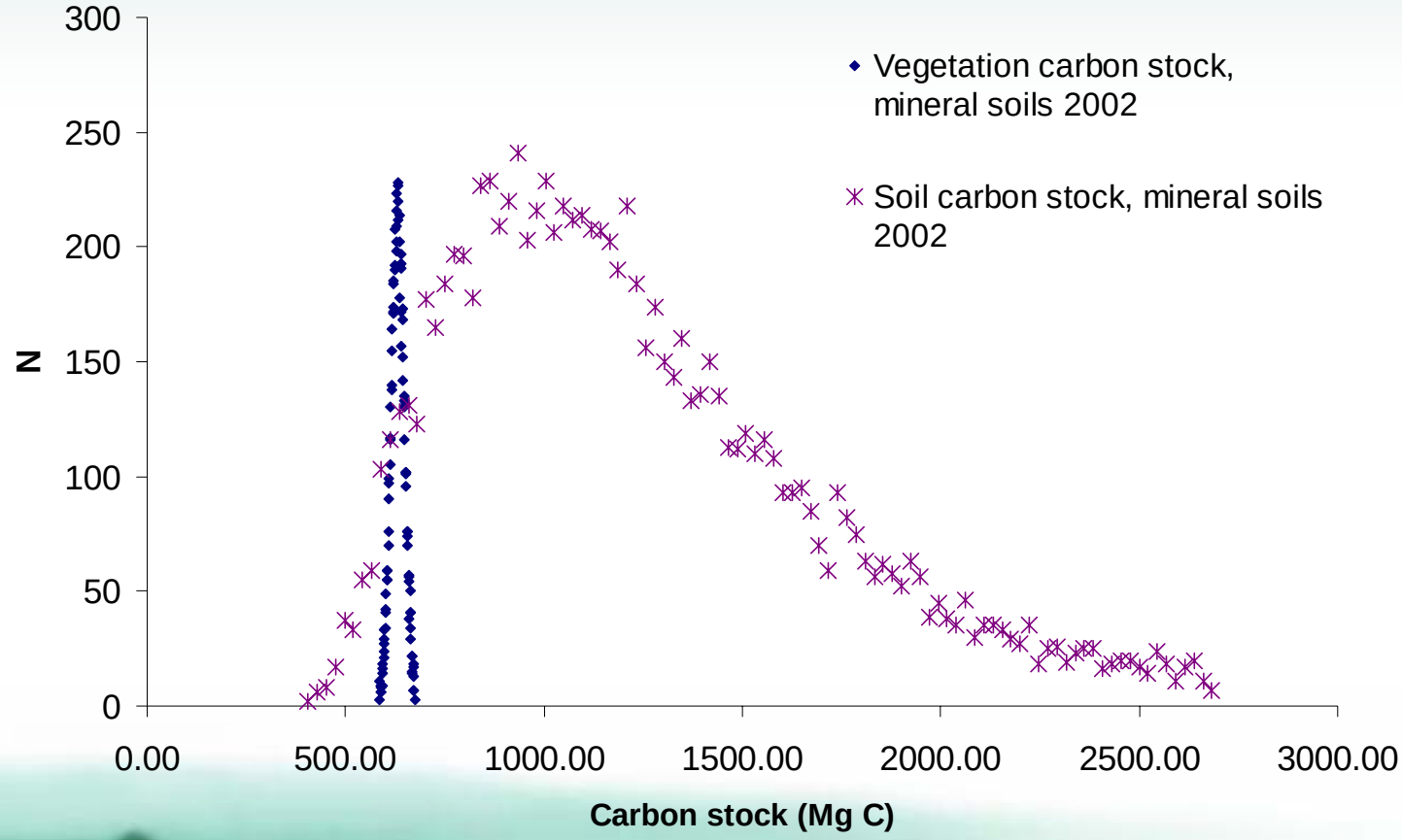
Forest vegetation carbon stock 2002



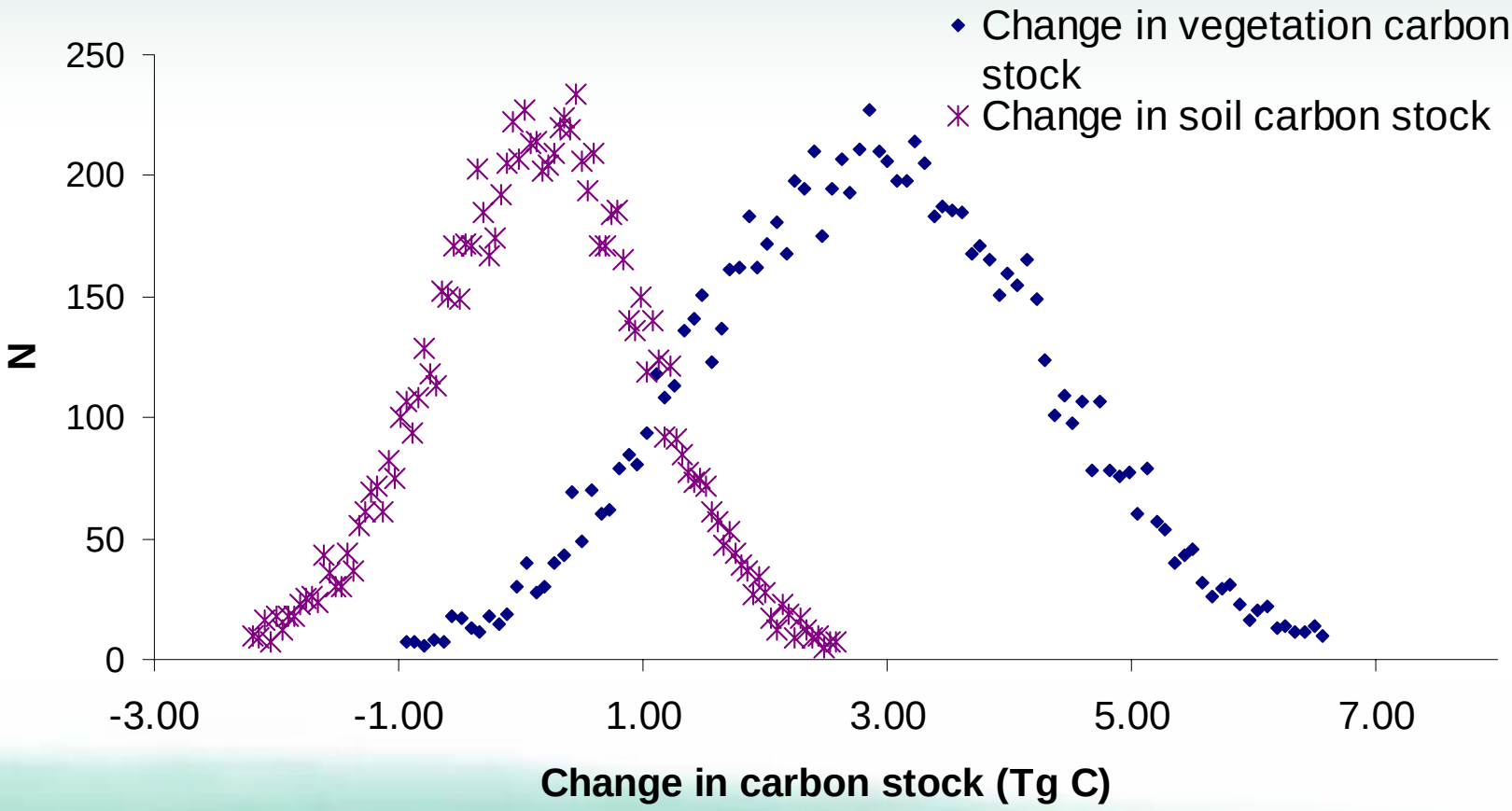
Change in vegetation carbon stock



Carbon stock of mineral soils



Carbon sink of forests on mineral soil, 2002



Key parameters affecting the C stock of veg.

Vegetation carbon stock 2002 Parameter	Contribution to variance with given uncertainty range
Carbon content	53,7%
understorey biomass, pine	13,8%
understorey biomass, spruce	1,6%
BEF-TOTAL pine, old stands	1,5%
BEF-TOTAL deciduos, 50 years	1,4%
BEF-TOTAL pine, mature stands	1,1%

Key parameters affecting the C sink of veget.

Vegetation carbon stock change 2002 Parameter	Contribution to variance with given uncertainty range
Growth index, 2002, spruce, south	21,2%
Growth index, 2002, pine, south	18,9%
Growth index, 2002, pine, north	6,8%
Growth index, 2002, deciduous, south	4,5%
Drain, 2002, pine, south	3,6%
Growth index, 2001, spruce, south	2,4%

Key parameters affecting the C stock of soil

Soil carbon stock 2002 Parameter	Contribution to variance with given uncertainty range
Yasso parameter, p_lig-all	33,0%
Yasso parameter, k_hum2-all	27,1%
Yasso parameter, p_hum1-all	12,2%
Yasso parameter, k_hum1-all	8,8%
Yasso parameter, p_cel-all	2,7%
Fine root biomass	0,9%

Key parameters affecting the soil C sink

Soil carbon stock change 2002 Parameter	Contribution to variance with given uncertainty range
Temperature sum, current year, South	42,4%
Temperature sum, current year, North	35,5%
Decomposition temperature sensitivity (beta)	2,2%
Temperature sum, previous year, South	1,9%
Temperature sum, previous year, North	1,7%
Yasso parameter, a_fwl-all	1,2%
Drain 2001, Spruce, South	1,2%

Conclusions

•The most influencial parameters affecting the stocks are different from the ones affecting the sinks/sources:

•Sinks/sources are sensitive to parameters that change in time:

Vegetation: Drain, annual variation in growth

Soil: Temperature sum and parameters sensitive to temperature

This work is a part of the joint project (Metla, VTT, EFI)

Uncertainty assessment of forest carbon balance

The objectives of the project

- to identify and quantify the sources of uncertainty in the carbon inventories of LULUCF sector
- to develop a model on these uncertainties
- to estimate the overall uncertainty in the carbon sink and source inventories of LULUCF sector and determine the key classes of LULUCF in relation to inventories of all other sectors

www.efi.fi/projects/uncertainty/